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FOR TODAY'S COMPETITIVE PUBLIC NETWORK MARKET

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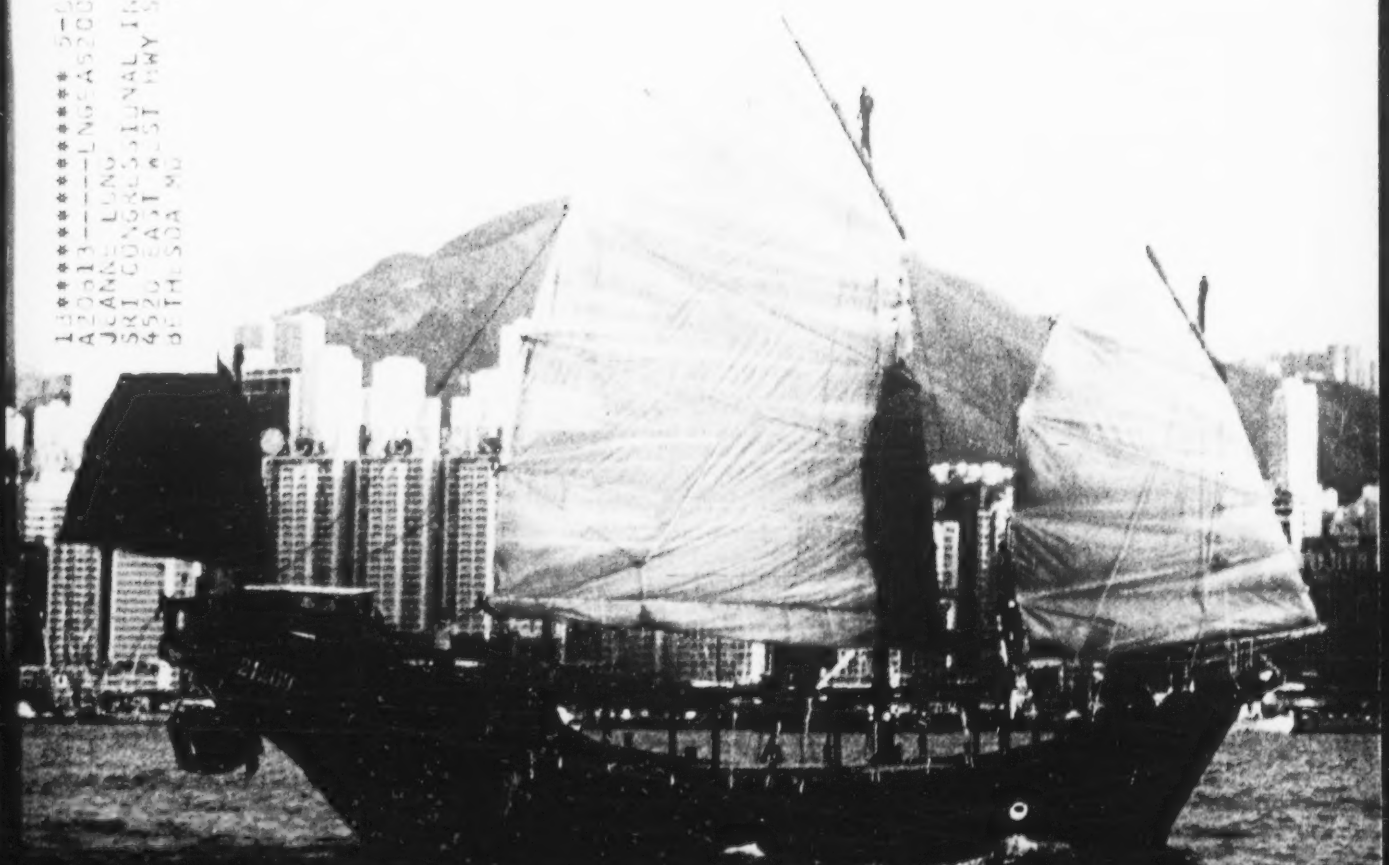

In the news. . .

AMERITECH AWARDS FITL 'MEGADEAL'

CARRIERS SCRAMBLE IN HURRICANE AFTERMATH

MONDAY, SEPTEMBER 7, 1992 Volume 223, No. 10

Telephony

FOR TODAY'S COMPETITIVE PUBLIC NETWORK MARKET

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ASIA'S FIBER GLOVE

By John Williamson. Lightguide technology fits the bill for the Asia/Pacific's long-haul telecommunications needs, with its short history of basic telecom infrastructure, geographically dispersed population. As evidenced by these regional updates, fiber subsea systems are helping to meet the area's demand for reliable, high-capacity, low-cost links, due to booming economies

Cover photograph by Harvey Lloyd, The Stock Market

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Telecommunications in China: Financing, debts and future growth

LIN SUN

China's telecommunications industry is experiencing the fastest growth in its history. During the 1980s, the industry achieved sustained double-digit growth. Revenue increased 24%, and public network switching capacity grew 11%. Such strong growth was bolstered by an increasing investment scale that grew at an astounding rate of 25% a year during the last decade.

In China's recent eighth five-year plan (1991-1995), and its 10-year economic and social development plan (1991-2000), telecom has been given high priority.

The Ministry of Posts & Telecommunications, says that China's telecom industry is expected to invest 35 billion yuan (87 billion) between 1991 and 1995, which translates to a 75% increase over the previous five-year period. By the end of the next decade, China should have achieved its goal of 33.6 million phone sets, or about three sets for every 100 people.

China's goal to almost triple the national telephone penetration in less than 10 years is a serious challenge. The nation's switching capacity will have to increase at least 15% a year to keep up.

The country's telecom industry boomed in the mid-1980s, propelled by economic reforms at home and the changing international telecom market that favored developing countries. China's telecom imports reached a peak in 1986; more than 70 transactions worth billions of dollars took place.

During the mid-1980s, the domestic market grew at an unprecedented pace; all major indices showed strong growth. Specifically, revenue increased 30% a year between 1986 and 1990. Switching capacity and the number of telephone sets increased 15% a year during the same period.

Encouraged by progressive policies in technology transfer, new technologies and products such as packet switching, digital microwave and fiber optic transmission were introduced rapidly, and there was increased research and development focused on the integrated services digital network, data communications gateways and various enhanced services.

With the rapid expansion that occurred in the 1980s, the centralized government financing soon showed serious deficiencies in allocating sufficient funds for both local and central expansion. According to the MPT, central financing decreased dramatically during the 1980s, from 60% of total telecom investment in 1983 to less than 9% by 1989.

In Guangdong (Canton) province, a locality with strong telecom growth, central financing decreased from 60% in 1980 to a meager 3% by 1987, while local self-financing increased more than 30 times during the same period.

The investment constraints and rapid growth forced the MPT to adopt a diversified financing policy, which transfers financing responsibility from the central government to local telecom authorities. Besides continued, but reduced central investment, the new policy encourages local telecom bureaus, enterprises and institutions to use all viable financial resources. These resources include local government and self-generated funds, and domestic and foreign loans.

Loans have had a dual effect on the industry: They provide foreign exchange for new technologies and products, but also have contributed to a growing national debt.

The MPT is primarily responsible for transnational—or Tier 1—networks, and local bureaus provide finances for provincial and regional networks (Table 1). Diversified financing gives local telecom bureaus more freedom. They can independently determine projects and funding scales and retain higher profits, as long as they meet tax requirements and regulations in technical standards, pricing and services. As a result, local communications infrastructure has generally improved in recent years.

Now that financing responsibility is done locally, profits depend on services, triggering rampant price increases. Since 1989, prices for local services have increased 30% to 100%. The price hike, however, is widely viewed in China as a natural adjustment from heavy government subsidies to more balanced market dynamics.

Despite the increases, the service waiting list also has soared, which indicates that consumers are willing to pay higher prices. The increases have provided a substantial pool of subscriber financing for service expansion and helped reduce debt loads.

The diversified financing policy also encourages foreign investments. Although foreign investments in China's telecommunications is a recent phenomenon, growth has been remarkable. Many foreign loans and joint ventures have been designated to local projects, bypassing the MPT. Because additional access to foreign exchange has become available, local bureaus can direct-

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TABLE 1 FINANCING PROVISION AND NETWORK STRUCTURE

Network types	Financing schemes
Transnational/ Tier 1	MPT
Interprovincial/Tier 2	Provinces and MPT
Interprovincial/Tier 3	Provincial bureaus
Intercity/Tier 4	City bureaus

TABLE 2
CITIES IN HIGHEST DEBT (1989)

Localities	Debt ratio*
Tianjin	51.8%
Shanghai	42.9%
Guangdong	22.3%
Beijing	17.6%
National average	18.9%

*Debts proportional to total annual investments

Source: MPT, 1991

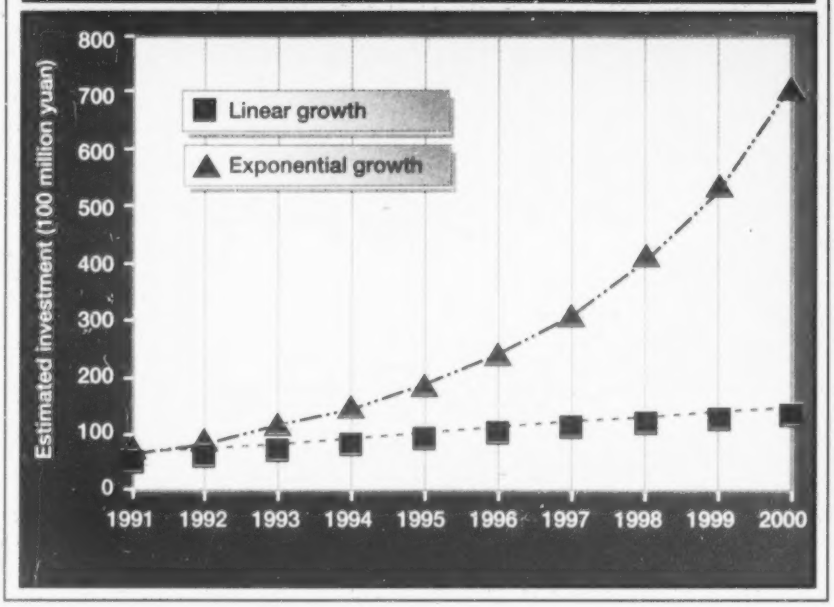
ly purchase foreign products, especially in regions where the economy and foreign trade is booming.

Because of the size and diversity of China's telecom market, the government may have to continue diversified financing as a long-term strategy. Decentralized financing has encouraged telecom investment, spurring growth.

China's telecom investment currently comes from three sources: state budgets, internal accumulation—including local government investment and enterprise revenues—and external sources such as loans and joint ventures. The MPT says by the end of 1989 China's telecom industry debt totaled 5 billion yuan; 60% was for basic construction (including plant and central office installation), 40% for system upgrading.

In both basic construction and systems improvements, foreign debts have accounted for 63% and 55%, respectively. Urban networks accounted for about 66% of the debt, compared to long-distance networks, which had little debt. Since most urban networks are constructed and managed locally, the debts are heavily weighted in provinces and cities whose infrastructure is comprised mainly of urban networks. Table 2 shows the localities with the highest debt ratio at the end of 1989.

FIGURE 1 FORECASTING SCENARIOS FOR TELECOM INVESTMENT (1991-2000)



The MPT believes China's telecom debt structure should be based on the nature of local networks and the pace of growth. For major cities such as Beijing, Shanghai, Guangzhou and Tianjin, the debt ratio can be as high as 40% because they have enormous urban networks and their repayment ability is higher. For remote and less developed areas that have primitive systems and produce little profit, the debt ratio should not exceed 10%. The MPT hopes such debt distribution will help accelerate urban network growth that accounts for more than 80% of all traffic in China, even though the average connect ratio is only 60%.

Compared to long-haul networks, urban systems will benefit from high demand and fast turnover in services, which makes it easier to repay debt.

Nonetheless, debt management in the 1990s could be a cause for concern. First, with many loans due by the early 1990s, China's ability to repay its debt will likely decrease. According to an MPT report, by 1995 the debts due will decline by as much as three times from 1989. Second, during 1991-95 China will increase investment in urban and long-distance networks, creating a reserve disparity of 20 billion yuan, aggravating investment constraints. Finally, to compensate for its debt, China will have to continue borrowing money.

Debts for the urban networks should remain heavy throughout this decade, but foreign loans may decrease in proportion to domestic loans because of stringent controls on foreign exchange expenditures and increasing domestic production and sales. Debts for long-haul networks will remain low because they depend less on cumulative investments and increasing rate of return over time.

The future debt structure must

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Where's the money?

China's diversified financing scheme depends on enterprise financing, user financing, loans, foreign investments and joint ventures.

Enterprise financing comes from sources such as telephone companies and product sales. Profit from phone services (including installation) will become the major source for enterprise financing, and it is expected to increase significantly because of an expanded user base and increase of service volume. User financing can be expanded from user premises installations (that is, PBXs and phones) to regional exchange, such as in the new industrial areas. Agreements can be made between local users and service carriers. Other alternatives can be explored in the future, such as selling telecom bonds to attract public financing.

Past experience indicates that local bureaus prefer government loans to bank loans because of lower interest rates and longer lending periods. Since the telecom industry requires long-term investment, loans with low-interest rates and longer terms are expected to grow.

Government concessional loans and commercial lending will be the major sources of financing in the 1990s. Although direct investment by foreign companies is encouraged, strict Ministry of Posts & Telecommunications regulation and government ownership will make direct foreign investment limited unless the industry is further decentralized to mixed ownership and management.

Successful joint ventures will continue to be an effective means for technology transfer and attracting foreign capital. They increase production, improve quality and also facilitate Western management, training and marketing that will help improve the quality and sales of Chinese products.

also consider industry efficiency and the dynamic relationship between market supply and demand. With dismantled government subsidies, the price for urban services has increased dramatically, thus creating an enormous revenue source for local carriers. According to MPT estimates, by 1995 total revenues from price increases alone will be 1.7 billion yuan, with a profit level of 20%.

As a result, debts for urban networks can be reduced by 10 billion yuan to 5.3 billion yuan by 1995. The MPT expects that by the end of 1995 the overall debt ratio will be reduced to 11%.

An analysis of the debt suggests an aggressive government policy to encourage continual local autonomy and financing diversification such as lower or exemptible taxes, lending in generous terms and contingent policy on foreign exchange expenditures.

Growth in the 1990s

Investment in the 1990s should grow from about 6.5 billion yuan in 1991 to 14.4 billion yuan by 2000 (without outstanding debts). But the annual growth rate is only about 7.9%, and this investment increase will be unable to sustain the projected growth. To have 33.6 million telephones in place by 2000, for example, the annual growth rate must be maintained at 15% or higher. This translates to an annual investment increase of 20% to 25%. If an upward investment scale of 20% a year is used, then 12 billion yuan is required by 1995, and 25 billion yuan by 2000.

Exponential growth is an alternative scenario (Figure 1). Using the exponential smoothing technique and ignoring seasonal factors, the scenario indicates significant growth around 1995. In addition, the scenario suggests a dramatic increase in investment to 70.5 billion yuan by 2000 from about 6 billion yuan in 1991, or an average growth rate of 31.6% for the 1990s. The exponential scenario, although obviously sufficient to meet China's goals, is unlikely.

These scenarios provide a framework for studying the future of Chinese telecom. The actual investment level probably will fall between the linear and exponential scenarios, depending on market and extraneous factors.

It is also possible to forecast the effects of estimated investment based on growth trends in the 1980s. Estimates for switching capacity and number of telephones are created with the previous linear and exponential investment models.

If the linear scenario is used, the switching capacity will increase to about 30 million lines and 32 million phone sets by 2000. If the exponential scenario is used, the growth will be 128 million lines and 141 million sets, respectively.

In the linear scenario, growth for both switching capacity and number of phones is somewhat below intended goals. But it will be impressive if the current momentum is maintained throughout the 1990s. The exponential scenario, on the other hand, shows dramatic growth, especially during the second half of 1990. It also requires a much higher investment.

How to increase industry financing is China's main dilemma. Future development relies heavily on increasing investment. Despite a strong commitment by the central government, the scale of central investment will likely stabilize with relatively little increments. The industry's growth in the '90s will depend on diversified financing.

The continuing dichotomy of power between the central and local governments will affect diversified financing throughout the 1990s. The long tradition of local autonomy in China is the result of a lack of policy directives and enforcement. Such inconsistency has created great opportunities for local telecom bureaus and enterprises to profit by providing better products and services in local markets.

Diversified financing is essential for China's growth in the 1990s. Policy-making must provide greater incentives to encourage local participation, autonomy and more profit retention. Prudent government policy will significantly improve the country's financial viability and promote technological advancement.

Lin Sutro is a Telecommunications Consultant based in San Francisco. This article is based on a recent report on China's telecom financing and growth.

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LINKING TELECOMMUNICATIONS AND ECONOMIC COMPETITIVENESS

Part one of two parts

FRANCIS J. CRONIN, PAUL HEBERT and ELISABETH COLLERAN

The issue of competitiveness is increasingly coming to dominate local, regional and national economic debates. Within the U.S., the decade-and-a-half-long string of sizable trade deficits has called into question the United States' ability to compete effectively in the international marketplace. Policy-makers, both here and abroad, have begun to focus on understanding the factors affecting an economy's ability to compete and grow.

Central to this discussion is the efficiency with which inputs such as labor, capital, materials and energy are combined in the production process—what economists call total factor productivity.

Traditionally, economists have examined capital and labor as the underlying drivers of growth. More recently, this analysis has been extended to account for improvements in the "quality" of capital and labor inputs as a result of such factors as research and development, and education.

In the 1980s, economists further expanded their concept of inputs to include public infrastructures. Public infrastructures such as transportation systems were recognized as pervasive networks with substantial implications for the productivity of the nation. In the past couple of years the concept of productive infrastructure has itself been expanded to encompass public networks owned, operated and maintained by private companies such as the U.S. telecommunications network.

The importance of identifying telecommunications as a productive input is undeniable. Many of today's high-growth industry prospects lie with information-intensive industries whose ability to communicate is critical to their ability to conduct business. Recent policy debates around the globe have begun to focus on the linkage between telecommunications and economic growth and competitiveness.

As a result, a number of jurisdictions are assessing the benefits of alternative telecommunications infrastructure modernization programs. What particular types of investment programs would impact the economy most favorably? Would the associated benefits exceed the cost? Over what time frame should the new network be deployed? What are the implications for specific segments of society such as low-income, elderly or disabled households; urban vs. rural economies; or public safety?

Over the past three years, researchers at DRI/McGraw-Hill have conducted the first and, to date, only comprehensive quantitative assessment of the contributions of telecommunications infrastructure modernization to the national and individual state economies. In this article, we describe the pervasive, profound and positive impacts that network modernization has had on the U.S. economy during the past 30 years.

The identifiable and measurable effects of network modernization include increased telecommunications production efficiencies, lower real service prices, increased end user productivity induced by higher usage, lower economy-wide inflation and increased international competitiveness.

FIGURE 1 TELECOMMUNICATIONS CONSUMPTION IN CONSTANT DOLLARS (1963-1982)

Investment, Productivity & Prices

The modern development of the U.S. telecommunications infrastructure has undergone three general stages. In the first stage, from the 1930s through the 1950s, telecommunications development was pursued to provide universal ser-

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vice. Once this goal was effectively achieved by the mid-1960s, the U.S. set out to modernize and improve the efficiency of its telecommunications network through investment in technological innovations designed to improve service and reduce the cost to customers. Since AT&T's divestiture in 1984, however, no clear public policy vision has directed the development of the telecommunications network.

To determine the effects of the earlier heavy investment period, we will focus on the early 1960s to the early 1980s. During these two decades, the U.S. undertook investments in telecommunications such as the widespread deployment of direct long-distance dialing, digital transmission facilities, satellite communications, the replacement of electromechanical switches with computer-controlled electronic switches and later with digital switching, and the extensive deployment of common channel signaling in the U.S. long-distance network.

During those two decades, public infrastructure investment experienced virtually no real growth; in fact, when measured relative to the gross national product, public infrastructure investment is found to have declined 40%. Telecommunications and gross private investment have shown significant real growth, with telecommunications investment growing more than three times and gross private investment more than two times their 1963 levels. Telecom investment growth has generally been about 50% greater than gross private investment growth.

Driven by these investments, the telecom industry increased its production efficiency to an extent unparalleled by any other U.S. industry. In fact, the total factor productivity of the industry climbed 3.1% per year, while productivity in the economy as a whole remained unchanged.

Almost as remarkable was the steadiness with which the telecommunications industry improved its productivity. It was one of a small set of industries generating substantial resource savings through the late 1970s, when most of the economy lapsed into a period of efficiency losses and was the only industry to lower its requirements in all three input categories (labor, capital and materials). Although decreases in real labor requirements were responsible for the majority of telecommunications efficiency gains, capital and materials requirements also dropped.

TABLE 1 RESOURCE SAVINGS DUE TO IMPROVED TELECOMMUNICATIONS

Savings	Sources of savings
$46.5 billion	Resources saved in telecommunications production
$52.0 billion	Resources saved from increased telecommunications consumption
($17.2 billion)	Resources used to accommodate increased demand for telecommunications
$81.3 billion	Total resources saved due to improved telecommunications

Design: Telephony/Peter D. Hynes

As a result of improvements in telecommunications production efficiencies between 1963 and 1982, we estimate that the nation's economy saved $46.5 billion in total resources in 1982.

These efficiency gains enabled the telecommunications industry to lower its price relative to the prices of other goods and services. Between 1963 and 1982 the price of telecommunications services fell 47% relative to the GNP price deflator and 49% relative to the average wage rate. Only two other industries—electrical machinery and textiles—cut relative prices by even half these amounts.

These changes not only revolutionized production processes in the industry itself, but affected the broader economy, particularly because telecom services are a vital and pervasive input into the production process of other sectors.

Industries throughout the U.S. economy responded to these price reductions by increasing consumption of telecommunications in their own production processes. The average industry spent 5¢ on telecommunications services to produce one unit of output in 1963; by 1982 it spent $1.43 (Figure 1). This represents a 167% increase in intensity of telecommunications usage, for a compound annual growth rate of 5.3%.

During that time, aside from personal services, no other industry experienced more than a 2% per year increase in use by any other sector in the economy. Most of the increase in telecom usage occurred in non-manufacturing sectors: Between 1963 and 1982, non-manufacturing usage of telecom climbed at a compound rate of 5.5% per year while manufacturing usage grew 3.7% per year. Virtually every industry expanded its usage of telecommunications per unit of output during that period.

Clearly, the advancement in the quality of telecom and the decline in real prices contributed to a dramatic increase in the consumption of telecom services. From a social viewpoint, however, the true value is the additional resources made available as telecom usage displaced less efficient and more costly resources.

To determine this, we estimated how user production processes would have been altered in 1982 if the advancements in telecommunication services between 1963 and 1982 had not occurred. We used a sophisticated econometric analysis, incorporating industry-specific production functions to develop a profile of the substitution possibilities available across industry sectors and the rates at which other resources can be substituted for telecommunications while maintaining output levels. In other words, industries would have had to increase their usage of such substitutes as labor, courier services or business travel to compensate for not being able to increase their use of telecommunications. This behavior is reflected in the substitution ratios developed using our state-of-

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the-art econometric model to relate the usage of capital, labor, materials and telecommunications by each industry to the prices of each input, the consuming industry's output, technology and the industrial structure of each industry.

The results of this complex analysis reveal that, in 1982, the average industry saved $1.64 (inflation adjusted) in other costs for every additional dollar spent on telecommunications. This savings was comprised of a 60.8% savings in labor costs and 39.2% savings in capital and materials.

For specific industries the cost savings were indeed extraordinary. For example, the same analysis demonstrates that the real estate sector could save $5.36 for every additional dollar spent on telecommunications in 1982 as compared with 1963.

With these estimates of resource substitutions across industry sectors, it is possible to estimate the total savings to the U.S. economy in labor and capital inputs in producing the 1982 level of GNP that results directly from advancements in telecommunications infrastructure between 1963 and 1982. We estimate that increased use of telecommunications saved the 1982 economy $52 billion in labor and capital. This savings was offset by a $17.2-billion increase in resources needed by the telecommunications industry to accommodate increased demand, for a net savings of $34.8 billion.

Table 1 shows how the combined impacts of improved production efficiencies by the telecommunications sector and increased telecommunications consumption by other sectors saved the 1982 economy $81.3 billion in labor and capital. In other words, had these gains in telecommunications efficiency not occurred, the economy would have had to use $81.3 billion more in primary inputs to achieve the level and composition of GNP actually produced in 1982.

The efficiency gains that have been attributed to advancements in telecommunications infrastructure in this time period have been reflected in the relative prices of other goods and services. Our analysis indicates that the U.S. Consumer Price Index in 1982 was 7% lower than it would have been without the increased used of telecommunications.

This may appear a rather esoteric measure, but since changes in the CPI greatly influence labor contracts, entitlement pay-outs, the standard of living and international competitiveness, it is an important yardstick for the value of telecommunications infrastructure to general economic well-being.

In fact, additional analysis by DRI reveals that this inflation-fighting property of telecommunications investment had a sizable impact on the U.S. trade position. Between 1977 and 1982, DRI calculates that U.S. exports increased by more than $50 billion as a result of our increased international competitiveness induced by telecom infrastructure improvements.

There are many ways in which the telecommunications sector, through infrastructure investment and the resulting efficiency gains and service price declines, improved the U.S. economy. Yet, it is often useful when comparing alternative investment activities to develop one overall measure that defines all societal benefits.

One way economists seek to quantify such societal impacts is through a cost/benefit analysis. DRI has developed analytics that discount the total flow of costs associated with the telecom infrastructure investment relative to the benefits to society. By the end of the time frame under analysis, benefits greatly exceed costs. In fact, the excess of discounted benefits over cost approaches 110%. This indicates a rate of return for society substantially greater than the rate employed by the federal Office of Management and Budget as a hurdle rate for the selection of public projects.

This private infrastructure investment profile, pursued by the U.S. telecom sector, has had a positive and profound effect across all dimensions of society, which may well be ahead of many public "social" investment programs. ■

Francis J. Cronin is Managing Director, and Paul Hebert and Elizabeth Colleran are Senior Associates of DRI/McGraw-Hill's Business Services Group, Lexington, Mass. Part two of this article will appear in the Nov. 2 issue.

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